論文 / 著書情報
Article / Book Information

題目(和文)	
Title(English)	Effect of catalyst preparation method of silver and manganese oxides on titanium dioxide on the decomposition of benzene using non-thermal plasma catalysis
著者(和文)	PANGILINAN CDC
Author(English)	Christian David Cruz Pangilinan
出典(和文)	学位:博士（工学）, 学位授与機関:東京工業大学, 報告番号:甲第9983号, 授与年月日:2015年9月25日, 学位の種別:課程博士, 審査員:日野出　洋文,中崎　清彦,小松　隆之,関口　秀俊,森　伸介
Citation(English)	Degree:, Conferring organization: Tokyo Institute of Technology, Report number:甲第9983号, Conferred date:2015/9/25, Degree Type:Course doctor, Examiner:,,,,
学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

（博士課程）
Doctoral Program

論 文 要 旨

THESIS SUMMARY

専攻： Department of	International Development Engineering 専攻	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of (Engineering)
学生氏名： Student's Name	Christian David Cruz Pangilinan	指導教員（主）： Academic Advisor(main)	Prof. Hirofumi Hinode
		指導教員（副）： Academic Advisor(sub)	

要旨（英文 800 語程度）
Thesis Summary (approx.800 English Words)

The emission of volatile organic compounds (VOCs) by industrial, commercial and agricultural processes are a major source of air pollution and is a concern for human health and the environment in general. Conventional methods for the abatement of VOCs include thermal oxidation, condensation, adsorption, absorption and catalysis. Thermal oxidation and condensation are only cost effective for moderate to high VOC concentrations while adsorption and absorption only transfers the pollutant to another medium and does not destroy them. In catalysis, drawbacks include high activation temperature and catalyst deactivation.

This thesis investigates the use of non-thermal plasma catalysis technology as an alternative method for volatile organic compound decomposition. As this technology is relatively new compared to other established technologies, much is still uncertain about this technology, particularly the reported synergistic effects between non-thermal plasma and catalysis. The mechanisms are rather complex due to the combined interaction of plasma together with heterogeneous catalysis. High input energy systems has shown to be capable in decomposing VOCs at wide range of concentrations and at varying degrees of mineralization. However, a problem present in this system is the formation of secondary pollutants primarily in the form of ozone and nitrogen oxides. Ozone can be easily decomposed thermally and have relatively short half-lives but nitrogen oxides are stable at low temperatures. Thus, aside from looking into the capability of the system to decompose VOCs, special attention must also be placed on effluent composition and concentrations.

This study focused on the use of differently prepared silver and manganese oxides on titanium dioxide and testing its catalytic activity on the decomposition of benzene in a non-thermal plasma driven catalysis system using a dielectric barrier discharge reactor. The different properties and characteristics of catalysts highly depend on their preparation method and greatly affects its performance when used in any catalytic process. Three types of catalysts: Ag/TiO_2, Mn/TiO_2, and $Ag\text{-}Mn/TiO_2$ and were prepared by impregnation method (IP) and by deposition-precipitation methods with sodium hydroxide (DPN) or hydrogen peroxide (DPH). The prepared catalysts were then characterized to determine their structural and chemical properties. Characterizations were performed using TG-DTA, XRD, N_2

adsorption BET method, XPS and SEM-EDS.

Dielectric barrier discharge characteristics depended on various conditions such as power supply, electrode and reactor configuration, dielectric materials, and operating gases. The effect of reactor length, TiO_2 catalyst loading, and reactor configuration on the discharge characteristics of the dielectric barrier discharge reactor and effluent concentrations of ozone and nitrogen oxides were also investigated.

Ozone generation efficiency is usually used as a good indicator in dielectric barrier discharge performance. Ozone is a powerful oxidant that is utilized in the decomposition of volatile organic compounds in non-thermal plasma catalysis systems. Unfortunately, when working with air plasma, the formation of nitrogen oxides cannot be avoided and this together with residual ozone are considered as secondary pollutants. The differently prepared catalysts were used to determine its effect on limiting ozone and nitrogen oxide generation.

Lastly, the decomposition of benzene using a plasma driven catalysis system was investigated. Based from the results, ozone and nitrogen oxide generation were limited in varying degrees by increasing the metal loading on the TiO_2 with the highest reduction observed with the catalysts with higher metal loading. For this part of the study, the catalysts loaded with 5% metal were used. Benzene decomposition, electron density, ozone and nitrogen oxide concentrations, carbon balance, carbon dioxide yield were investigated for the activity tests.

Air plasma treatment showed 18.39% decomposition of benzene with a carbon balance of 82.78% and a carbon dioxide yield of 6.35%. This indicated that air plasma by itself can decompose benzene to a certain degree but showed incomplete mineralization to carbon dioxide. Addition of catalysts improved not only benzene decomposition but also showed higher values for carbon balance and carbon dioxide yield. Also, ozone and nitrogen oxide concentrations were significantly reduced. An increase in electron density was observed but did not necessarily improve benzene decomposition. From the catalysts that were used, silver loaded TiO_2 showed an improvement in carbon balance and carbon dioxide yield while manganese loaded TiO_2 showed an improvement in benzene decomposition and reducing concentrations for ozone and nitrogen oxide. Using both silver and manganese on TiO_2 showed a combination of these effects with Ag-Mn/TiO_2 prepared by DPN method showing the highest benzene decomposition efficiency at 33.55%, carbon balance at 99.28% and carbon dioxide yield of 97.85%.